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DRAWINGS ATTACHED

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(54) SPRING BRAKE CONTROL VALVE

(71) We, BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY, a corporation organised and existing under the laws of the State of Delaware, United States of America, of 901 Cleveland Street, Elyria, Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a valve for controlling fluid pressure released, spring applied emergency brakes in a dual circuit vehicle braking system.

Fluid pressure released, spring applied emergency brakes are well known and comprise a spring actuator whose spring is held in compressed inactive condition by fluid pressure supplied to a release chamber. When this pressure is released, the spring expands and applies a plunger to the push plate of an adjacent service brake chamber to apply the brakes solely through the action of the spring. Automatic valve arrangements are provided to release the pressure when the service or emergency pressure in the braking system falls to an unsafe low level. Heretofore, the automatic release arrangement has operated to instantly vent the release chamber of the spring brake to atmosphere with the result that the spring brakes have been abruptly applied on to their fullest extent so as to bring a vehicle to an immediate halt and this can be extremely dangerous on a crowded highway.

The problem of brutal spring brake applications in emergencies is compounded in dual circuit braking systems wherein the front brakes, for example, are controlled by one circuit having its own pressure source and the rear brakes, including also the spring application means, are controlled by the second circuit and its own separate pressure source, the respective service brakes supplied by the two circuits being controlled by a pair of tandemly mounted brake valves responsive to the movement of a single brake pedal. In a dual circuit braking system, it is desirable to have the emergency brakes automatically applied upon loss of pressure in one of the circuits.

It is an essential object of the present invention to avoid the danger of brutal application of the emergency spring brakes by providing means for gradually releasing the pressure from the release chamber of the spring brake and more precisely by providing, for use in a dual circuit brake system, valve means which will automatically, upon the loss of service brakes in one of the circuits, graduate or release at a controlled rate the pressure from the spring brakes so that a vehicle is brought to a gradual stop.

According to the invention there is provided a control valve for controlling spring applied, fluid-pressure released brake actuators in a dual circuit vehicle braking system including fluid pressure responsive service brake actuators for two separate sets of brakes, at least one of said set of brakes having also spring applied, fluid-pressure released brake actuators, said control valve comprising a valve control member having opposed fluid-pressure receiving surfaces adapted to receive through respective ports the fluid pressure supplied to the service actuators of the respective sets of brakes during a brake application, said control member being urged by a spring to maintain a normal position of a valve arrangement and remaining inactive when the fluid pressure is substantially equal at both ports, wherein the control member comprises an upper and a lower moving wall interconnected by an axially extending valve control rod which passes through a fixed partition wall, said partition wall and the lower moving wall defining an enclosure which contains the valve arrangement and communicates with a delivery port adapted to be connected to the spring brake actuator, with an inlet port adapted to be connected to a fluid pressure source, and with an exhaust port communicating with atmosphere, said valve arrangement being movable in response to the positions of the control member from the normal position where the inlet port

[

communicates with the delivery port while the exhaust port is isolated, to a balancing position where all communications are closed, and then to a release position where the delivery port communicates with the exhaust port while the inlet port is isolated, said delivery port being so located as to communicate at all times with the upper surface of the lower moving wall, thus exposing this surface to a fluid pressure force opposed to the force of the spring acting on the control member, whereby, should the fluid pressure controlling one set of service brakes exceed by a predetermined amount the fluid pressure controlling the other, combined forces developed against the force of the spring by the difference of the service fluid pressures and by the fluid pressure at the delivery port will move the valve arrangement to its release position and relieve the fluid pressure at the delivery port, until said combined forces are overbalanced by the force of the spring to move the valve to its balancing position.

The present invention will now be described in the form of two preferred embodiments with reference to the accompanying drawings, in which:—

Figure 1 is a schematic representation of a dual circuit fluid pressure brake system incorporating a valve embodying the features of the present invention, and

Fig. 2 is a view similar to Fig. 1 but showing a modification of the control valve of Fig. 1.

Referring now to the drawings, Fig. 1 illustrates a dual pressure braking system comprising a reservoir 10 having an outlet through a check valve 12 to a reservoir 14 by way of a pressure protection valve 16 such as that shown in the Patent Specification No. 1024524 which automatically closes at a predetermined pressure to prevent the passage of fluid therethrough when the pressure on the upstream side has fallen to the predetermined level.

The reservoirs 10, 14 have respective outlet pipes 18, 19 leading to the inlet cavities of lower and upper parts 20, 21 of a dual pressure brake valve 22 which may be of the type shown in Patent Specification No. 1058043.

Leading from the parts 20, 21 of the brake valve 22 are a pair of outlet pipes 24, 26 connected respectively to the rear and front service brakes of a truck or trailer. The rear or trailer service brakes, indicated by the numeral 27, include the usual brake chamber 28 and push rod 30 and include also a tandemly mounted spring brake 32 having a release chamber 34, to and from which pressure is admitted and exhausted by way of a pipe 36 to control the spring brake.

The pipe 36 is connected to delivery port 42 of a control valve 46 constructed in accordance with the present invention. The delivery port 42 leads into a delivery cavity 48 in the valve body 50 and the delivery cavity 48 is connected to an inlet cavity 52 through a central inlet port 60 surrounded by an inlet valve seat 62 engageable by a valve closing member 64 to disconnect the inlet and delivery cavities 52, 48, the closing member 64 forming part of a combined inlet and exhaust valve.

The combined inlet and exhaust valve closing member 64 is also engageable by an exhaust valve 66 defined by the peripheral edge of a central boss 67 carried by an emergency piston 68 which is urged at all times by a relatively heavy spring 70 acting against a lower cover member 72 and against the piston 68 as shown to urge the exhaust valve seat 66 into engagement with the combined exhaust and inlet valve closing member 64 so as to disconnect the delivery cavity 48 from an exhaust passage 74 in a sleeve member 76 carrying the valve closing member 64 and connected to atmosphere through an exhaust cavity and port 78, 80. The sleeve 76 sealingly slides through a wall member 82 and a light spring 84 acts between the lower surface of the wall member and the upper surface of a valve guide 86 to urge the sleeve 76 and the valve closing member 64 in the direction of the inlet valve seat 62.

The inlet cavity 52 is connected by way of a port and pipe 87, 88 with the outlet of a parking valve 90 having an inlet which is connected as shown to reservoir 10. The valve 90 is provided with a control handle 92 which, in the solid line position of the drawing, connects the reservoir 10 with the inlet port 87 of the valve 46 and when the handle is moved to the dotted line position, the valve 90 serves to disconnect the reservoir 10 from the inlet port 87 while connecting the latter to atmosphere through an exhaust port 94. If desired, a small fluid pressure actuator 96 can be connected by way of suitable piping to the service pipe 24 so that the handle 92 is moved to the full line position of the drawing during a normal service brake application to ensure that pressure is admitted to the release chamber of the spring brake so as to prevent possible doubling up of braking effort on the slack adjuster.

Referring again to the valve 46, it will be noted that the cover member 72 defines with the piston 68 a pressure chamber 97 which is connected by way of a port 98 and pipe 100 with the service conduit 24 connected to the outlet or delivery side of the lower part of the dual brake valve 22. Thus when service pressure is delivered from the lower part of the valve 22 to the service pipe 24 it is simultaneously delivered by way of the pipe 100 and port 98 to the chamber 97 beneath the piston 68 where it acts in concert with the spring 70 to retain the piston 68 in the position of the drawing with the exhaust valve seat 66 engaging the combined exhaust and inlet valve closing member 64 to disconnect the delivery cavity 48 from the exhaust port 80 while, at the same time, disengaging closing member 64

from inlet valve seat 62 to freely connect the inlet port 87 and cavity 52 with the delivery cavity and port 48, 42.

The upper end of the valve 46 is provided with a closure member 102 having a central port 104 therethrough which is connected by way of a pipe 105 with the service pipe 26 connected to the delivery side of the upper part 21 of the dual brake valve 22. The inner side of the closure member 102 defines with the upper side of a piston 106 a pressure cavity 108 which receives the same service pressure which is delivered to the front service brakes by the brake valve 22. The lower side of the piston 106 is exposed to atmosphere through port 107 and is provided with an extension 110 which is slidably and sealingly received in a central opening of a wall member 112. Integral with the extension 110 is a plunger 114 of reduced diameter which is in tight engagement with a recess 116 in the boss 67 on the upper side of the piston 68, the arrangement being such that the upper piston 106 and the lower piston 68 are so connected together that they move in unison.

In operation, let it be first assumed that the reservoirs 10, 14 contain fluid at a pressure above a predetermined safe level. Under normal conditions, the operator moves the handle 92 of the parking valve 90 to the full line position whereupon fluid pressure is admitted from the reservoirs through the valve 90 to the pressure chamber 34 of the spring brake by way of the inlet port and cavity 87, 52, the central port 60, delivery cavity and port 48, 42 and pipe 36 to move the spring brake to its inactive or release position.

With the spring of the spring brake de-activated by pressure as above described, when the operator depresses the brake pedal of the dual circuit brake valve 22, service pressure is delivered by way of the pipes 24, 26 to the rear service brake chambers 28 and to the front brake chambers to apply the brakes. Simultaneously, service pressure is delivered by way of the pipes 105, 100 to the upper and lower ports 104, 98 to act downwardly on the upper piston 106 and upwardly in concert with the spring 70 on the lower piston 68. In view of the fact that the combined force of the spring and pressure acting on the lower piston is greater than the pressure force acting downwardly on the piston 68 and on the upper piston 106, the parts of the valve remain in the position of the drawing and the spring brake remains de-activated just as if the valve 46 were not in the circuit. Under normal conditions, if the operator, after bringing the vehicle to a stop, wishes to park the vehicle by the spring brake, he merely moves the parking handle 92 to the dotted line position whereupon the fluid pressure in the release chamber 34 of the spring brake is connected to the atmospheric port of the parking valve through the valve 46 again, exactly as if the latter were not in the circuit.

Assume now that the fluid pressure for the rear service and/or trailer brakes is depleted or a leak develops in conduit 24. Under these conditions, the pressure protection valve 16 closes and of course the check valve 12 closes so that pressure is trapped in the release chamber 34 of the spring brakes to retain these in released position. Under these conditions, when the operator next applies the brakes, which obviously will be in a place where brake application or vehicle slow-down is appropriate in any event, service pressure will be delivered by way of the pipe 26 to the upper piston 106, but in view of the fact that there is no pressure available for delivery to beneath the lower piston 68, the service pressure acting downwardly on the upper piston 106 in concert with release pressure acting on the top of piston 68 exerts sufficient force thereon to overcome the upward force of the lower spring 70 whereupon the plunger 114 is moved downwardly against the force of the spring 70 to first close off the inlet port between the inlet and delivery cavities 52, 48 of the valve 46 and thereafter to open the exhaust port between the cavity 48 and the exhaust passage 74. Because the pressure in the release chamber 34 of the spring brake had also been acting downwardly on the piston 68 in concert with the downward force of the service pressure acting on the upper piston 106, as the pressure in the release chamber 34 is exhausted to atmosphere, the force of the spring 70 will move the piston 68 upwardly until the exhaust valve seat 66 laps whereby pressure is momentarily trapped in the release chamber 34 to prevent the spring from expanding to its fully applied position. If the pressure in the upper cavity 108 is permitted to increase it again moves the piston 106 downwardly to reopen the exhaust valve and relieve additional pressure from the release chamber 34 whereby the pressure is relieved from the spring brake chamber 34 until the valve again laps with the spring brake being only partially applied which may be sufficient to bring the vehicle to a safe but gradual stop without the danger of a brutal application of the brakes.

With reference now to Fig. 2, the valve 120 there illustrated is substantially identical to the valve 46 of Fig. 1 and includes a pair of inlet ports 122, 124 connected respectively to the upper and lower delivery sides of a dual pressure brake valve 125 controlling service braking to separate sets of brakes, one of which may include a spring brake 127 as shown. The valve 120 also has an inlet port 126 which may be connected by way of a parking valve (not shown) with a source of fluid pressure and a delivery port 128 which is connected to the release cavity 130 of the spring brake 127.

The inlet ports 122, 124 lead to cavities 132, 134 on opposite sides of an upper piston 136 having a hollow plunger 138 connected to an exhaust port 139 and slidably receiving a sleeve 140 carrying at its lower end a combined inlet and exhaust valve closing member 142 adapted to cooperate with an inlet valve seat 144 surrounding a port 145 connecting an inlet cavity 146 with a delivery cavity 148. The lower wall of the delivery cavity 148 is defined by the upper side of a cup shaped piston 149 which is urged to the position of the drawing by adjustable spring 150 so that an exhaust valve seat 152 carried by a boss 154 integral with the piston 149 engages the element 142 to disconnect the exhaust port 139 from the delivery cavity 148 while remaining the closing member 142 out of engagement with the seat 144 so as to connect the inlet and delivery cavities 146, 148.

As so far described the valve 120 is similar to the valve 46 of Fig. 1 differing primarily in that in the former service pressure from the circuit connected to the combined service and spring brakes is led to the cavity 134 beneath the upper piston rather than to the cavity 97 beneath the piston as in Fig. 1. With this arrangement the spring 150 may be adjusted by an adjusting bolt 156 so that the piston 149 is responsive to a selected pressure at the inlet port 126 to move downwardly and lap the valve closing member 142 as soon as a predetermined pressure just sufficient to release the brakes has been delivered to the release chambers of the spring brakes. Thus the piston 149 and the valve closing member 142 serve as a pressure regulating valve to prevent the delivery to the spring brake release chamber of more pressure than is required to release the brakes. Such unloaded additional pressure creates a delay problem in setting the spring brakes due to the additional time required to blow down the unneeded high pressure in the release cavity until the spring brakes apply.

From the foregoing it will be apparent that in the valve of Fig. 2, the inlet and delivery cavities are normally disconnected and the inlet and exhaust valves are lapped. Under these circumstances, it can be seen that when the parking valve is operated to apply the spring brakes, the spring brakes might not respond due to possible trapping of release pressure in the spring brake release chamber. To prevent this, a check valve 160 serves to by-pass the lapped valve element 142 to ensure that the pressure in the release chamber is relieved through the parking valve at the will of the operator.

In the event that service pressure is not delivered to these brake chambers carrying the spring brakes, then service pressure is also not delivered to the cavity 134 beneath the upper piston 136. Under these circumstances when the operator depresses the brake pedal for a normal (i.e., less than full) brake application, the piston 136 is moved downwardly to open the exhaust valve 152 and connect the spring brake release chamber to atmosphere through the exhaust port 139. When the pressure in the release chamber and hence the pressure acting on the upper side of the emergency piston 149 has blown down sufficiently the exhaust valve again laps resulting in a partial or graduated application of the spring brake precisely as in the case of the valve of Fig. 1.

From the foregoing it should be apparent that the valves of the invention permit controlled application of the spring brakes rather than the abrupt application as heretofore. Additionally, the invention provides a valve which accomplishes the foregoing while at the same time it operates as a pressure regulating valve to prevent the delivery of unneeded excessive pressure to a spring brake which might delay the controlled application of the brake.

WHAT WE CLAIM IS:—

1. A control valve for controlling spring applied, fluid-pressure released brake actuators in a dual circuit vehicle braking system including fluid pressure responsive service brake actuators for two separate sets of brakes, at least one of said set of brakes having also spring applied, fluid-pressure released brake actuators, said control valve comprising a valve control member having opposed fluid-pressure receiving surfaces adapted to receive through respective ports the fluid pressure supplied to the service actuators of the respective sets of brakes during a brake application, said control member being urged by a spring to maintain a normal position of a valve arrangement and remaining inactive when the fluid pressure is substantially equal at both ports, wherein the control member comprises an upper and a lower moving wall interconnected by an axially extending valve control rod which passes through a fixed partition wall, said partition wall and the lower moving wall defining an enclosure which contains the valve arrangement and communicates with a delivery port adapted to be connected to the spring brake actuator, with an inlet port adapted to be connected to a fluid pressure source, and with an exhaust port communicating with atmosphere, said valve arrangement being movable in response to the position of the control member from the normal position where the inlet port communicates with the delivery port while the exhaust port is isolated, to a balancing position where all communications are closed, and then to a release position where the delivery port communicates with the exhaust port while the inlet port is isolated, said delivery port being so located as to communicate at all times with the upper surface of the lower moving wall, thus exposing this surface to a fluid pressure force opposed to the force of the spring acting on the control member, whereby, should the

fluid pressure controlling one set of service brakes exceed by a predetermined amount the fluid pressure controlling the other, combined forces developed against the force of the spring by the difference of the service fluid pressures and by the fluid pressure at the delivery port will move the valve arrangement to its release position and relieve the fluid pressure at the delivery port, until said combined forces are overbalanced by the force of the spring to move the valve to its balancing position.

2. A control valve according to claim 1, characterized in that the service fluid pressures communicates with either surface of the upper moving wall, and in that the spring is acting on the outer surface of the lower moving wall and is provided with means for adjusting the resilient force with which it opposes the movement of the control member in response to the fluid pressure at the delivery port.

3. A control valve according to claim 2, characterized in that the resilient force of the spring is adjusted to a value controlling the balancing position of the valve means when the fluid pressure at the delivery port is at a predetermined value.

4. A valve constructed, arranged and adapted to operate substantially as described herein above and as illustrated in the accompanying drawings.

5. A dual circuit vehicle braking system including a control valve according to any one of the preceding claims.

6. A vehicle braking system according to claim 5, characterized in that it includes a by pass passage connecting the delivery and inlet ports around the valve arrangement and a one-way check valve in said passage arranged to permit fluid flow from said delivery to said inlet ports, but not in the reverse direction.

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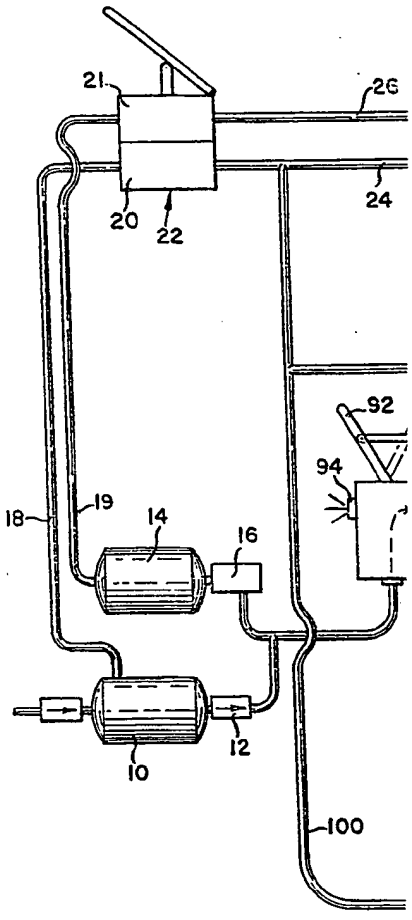

1252169 COMPLETE SPECIFICATION

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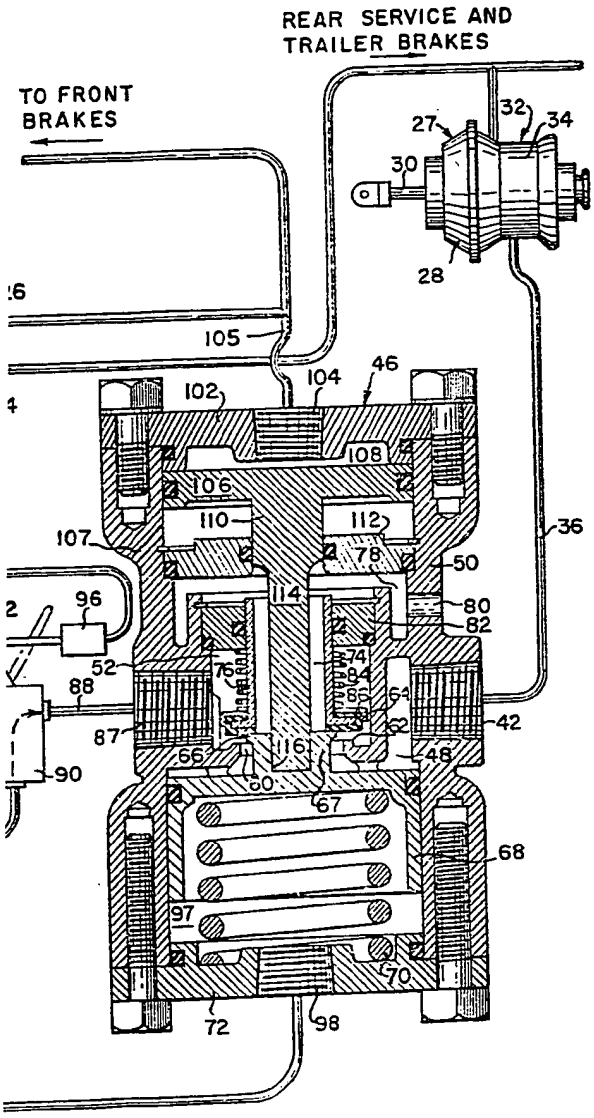

Fig. 1

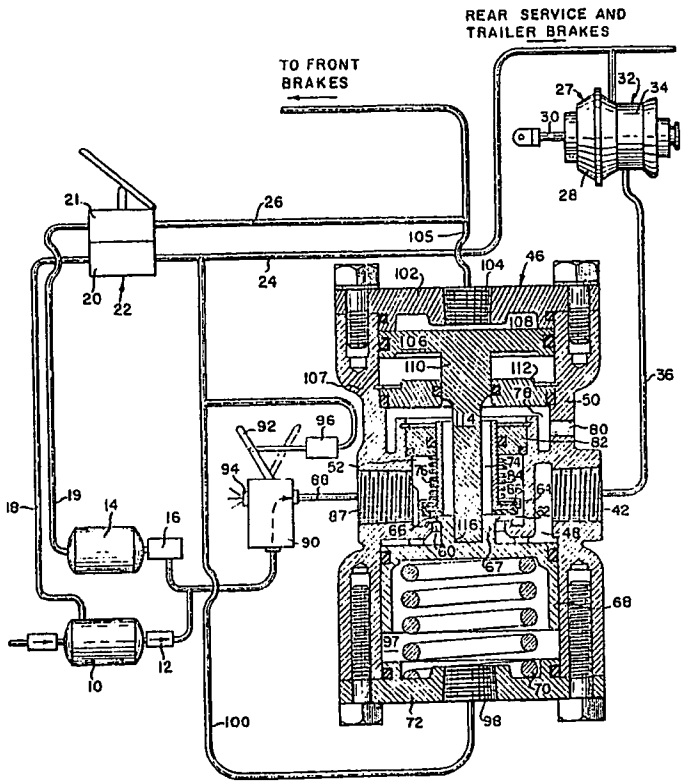

Fig. 1

1252169 COMPLETE SPECIFICATION

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Sheet 2

ONT BRAKES

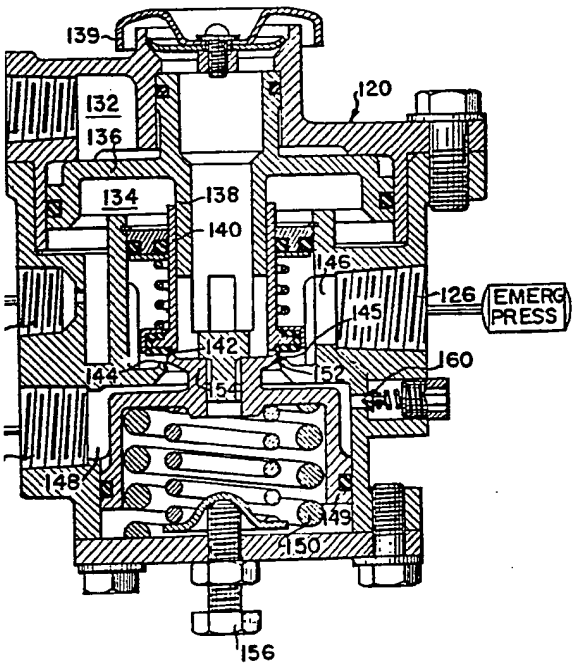

Fig. 2

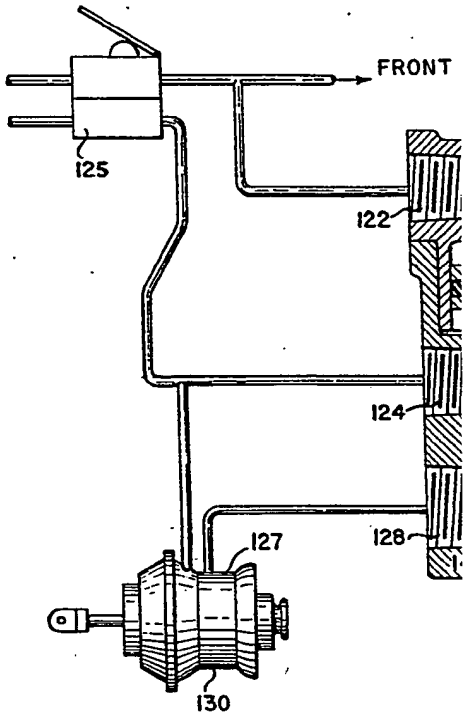

Fig.

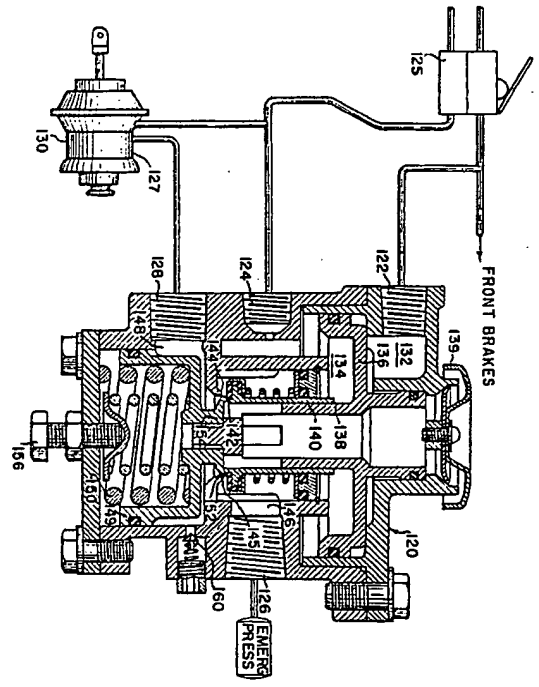

FIG. 2